PersoNER: Persian Named-Entity Recognition

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Abstract

Named-Entity Recognition (NER) is still a challenging task for languages with low digital resources. The main difficulties arise from the scarcity of annotated corpora and the consequent problematic training of an effective NER pipeline. To abridge this gap, in this paper we target the Persian language that is spoken by a population of over a hundred million people world-wide. We first present and provide ArmanPerosNERCorpus, the first manually-annotated Persian NER corpus. Then, we introduce PersoNER, an NER pipeline for Persian that leverages a word embedding and a sequential max-margin classifier. The experimental results show that the proposed approach is capable of achieving interesting MUC7 and CoNNL scores while outperforming two alternatives based on a CRF and a recurrent neural network.

1 Introduction

Named-Entity Recognition (NER), introduced in the sixth Message Understanding Conference (MUC-6) (Grishman and Sundheim, 1996), concerns the recognition of Named Entities (NE) and numeric expressions in unstructured text. Since 1996, great effort has been devoted to NER as a foundational task for higher-level natural language processing tasks such as summarization, question answering and machine translation.

Shortage of gold standards has initially limited NER investigation to high-resource languages such as English, German and Spanish (Tjong Kim Sang and De Meulder, 2003). Gradually, publicly available encyclopediae have enabled combinations of semi-supervised and distant supervision approaches for other languages (Althobaiti et al., 2015). However, low-resource languages still face a significant scarcity of public repositories. For instance, only 8.8% of Wikipedia articles in Hindi are identified as entity-based articles in Freebase (Al-Rfou et al., 2015). In this work, we aim to enable supervised NER for a low-resource language, namely Persian, by providing the first manually-annotated Persian NE dataset. The Persian language, despite accounting for more than a hundred million speakers around the globe, has been rarely studied for NER (Khormuji and Bazrafkan, 2014) and even text processing (Shamsfard, 2011). In addition, we present PersoNER, a Persian NER pipeline consisting of a word embedding module and a sequential classifier based on the structural support vector machine (Tsochantaridis et al., 2005). The proposed pipeline achieves interesting MUC7 and CoNNL scores and outperforms two alternatives based on a CRF and a recurrent neural network.

2 Related Work

Early research on NER was mostly devoted to handcrafted rule-based systems which are intrinsically language-dependent, and thus laborious to be extended to new languages. As a consequence, recent studies are mainly focused on language-independent machine learning techniques that attempt to learn

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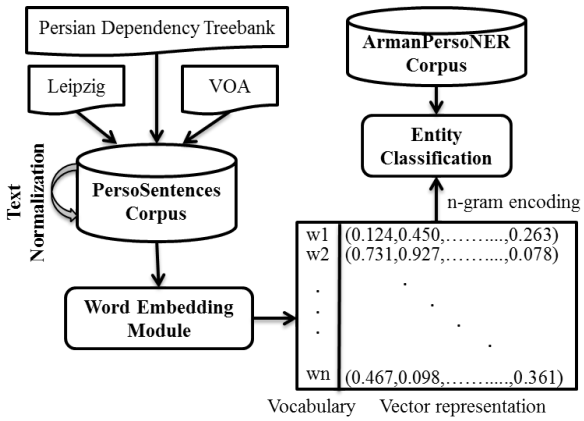

Figure 1: PersoNER workflow.

statistical models for NER from data (Nadeau and Sekine, 2007). Moreover, replacement of manually-annotated gold standards with very large "silver standard" corpora mollifies the scarcity of supervised data. Silver standards are NE annotated corpora derived from processing Wikipedia's text and meta-information alongside entity databases such as Freebase (Nothman et al., 2013; Al-Rfou et al., 2015).

Existing NER approaches mainly divide over two categories: in the first, the task is decoupled into an initial step of word embedding, where words are mapped to feature vectors, followed by a step of word/sentence-level classification. The feature vector can be as simple as a binary vector of text features like '*word is all uppercased*' or a more complex, real-valued vector capturing semantic and syntactic aspects of the word. Word2vec (Mikolov et al., 2013), GloVe (Pennington et al., 2014) and Hellinger-PCA (Lebret and Collobert, 2014) are well-known examples of unsupervised word embeddings applied successfully to the NER task. For classification, sequential classifiers such as HMMs (Zhou and Su, 2002), CRFs (Lafferty et al., 2001; Finkel et al., 2005) and deep neural networks (Al-Rfou et al., 2015) have been amongst the most popular choices.

The second category, proposed by (Collobert et al., 2011) and recently followed by many including (Mesnil et al., 2013; Mesnil et al., 2015) and others, leverages recurrent neural networks (RNNs) to deliver end-to-end systems for NER. With this approach, an implicit word embedding is automatically extracted in the network's early layers by initializing the training with random values or a preliminary embedding. In this paper, we apply and compare approaches from both categories.

3 The Proposed Approach

The workflow of PersoNER is illustrated in Figure 1. The steps include data collection, text normalization, word embedding and entity classification. In this section, we focus on the two technical modules, word embedding and classification, while data collection and text normalization are described in Section 4.

3.1 Word Embedding

Term-frequency (tf), term-frequency inverse-document-frequency (tf-idf), bag of words (bow) and word co-occurrence are general statistics intended to characterize words in a collection of documents. Out of them, word co-occurrence statistics have the ability to represent a word by the frequencies of its surrounding words which well aligns with the requirements of NER. Recently, Lebret and Collobert (2014) have shown that a simple spectral method analogous to PCA can produce word embeddings as useful as those of neural learning algorithms such as word2vec. Given an unsupervised training corpus and a vocabulary, V, the co-occurrence matrix, $C_{|V|\times|D|}$, in (Lebret and Collobert, 2014) is computed as:

$$C(v_i, d_j) = p(d_j|v_i) = \frac{n(v_i, d_j)}{\sum_d n(v_i, d)} \quad (1)$$

where $v_i \in V; i = 1 \dots |V|$ and $d_j \in D \subseteq V; j = 1 \dots |D|$. $n(v_i, d_j)$ is the count of occurrences of context word d_j in the neighborhood of reference word v_i. Thus, $C(v_i, :)$ represents discrete probability distribution $p(d|v_i)$ and is used to characterize v_i. Since words are represented as discrete distributions, Lebret and Collobert (2014) argue that it is more appropriate to measure their distances in a Hellinger space. Accordingly, $H(C)$ is the transformation of C into Hellinger space where the distance between any two discrete probability distributions, P and Q, is given by:

$$dist(P, Q) = \frac{1}{\sqrt{2}} ||\sqrt{P} - \sqrt{Q}||_2. \tag{2}$$

Eventually, PCA is applied to reduce the dimensionality of $H(C) \in \mathbb{R}^{|V| \times |D|}$ to $h(C) \in \mathbb{R}^{|V| \times m}$, where $m \ll |D|$.

3.2 Classification

In this subsection, we first briefly introduce sequential labeling as a formal problem and then describe the sequential classifier based on the structural support vector machine.

3.2.1 Sequential Labeling

Sequential labeling predicts a sequence of class labels, $y = \{y_1, \dots y_t, \dots y_T\}$, based on a corresponding sequence of measurements, $x = \{x_1, \dots x_t, \dots x_T\}$. It is a very common task in NLP for applications such as chunking, POS tagging, slot-filling and NER. A widespread model for sequential labeling is the hidden Markov model (HMM) that factorizes the joint probability of the measurements and the labels, $p(x, y)$, by arranging the latter in a Markov chain (of order one or above) and conditioning the measurement at frame t on only the corresponding label. For an HMM of order one, $p(x, y)$ is expressed as:

$$p(x, y) = p(y_1) \prod_{t=2}^{T} p(y_t|y_{t-1}) \prod_{t=1}^{T} p(x_t|y_t) \tag{3}$$

where $p(y_1)$ is the probability of the initial class, terms $p(y_t|y_{t-1})$ are the transition probabilities and terms $p(x_t|y_t)$ are the emission, or measurement, probabilities. By restricting the emission probabilities to the exponential family, i.e., $p(x_t|y_t) \propto exp(w^T f(x_t, y_t))$, the logarithm of probability $p(x, y)$ can be expressed as the score of a *generalized linear model*:

$$\begin{aligned} &\ln p(x, y) \propto w^T \phi(x, y) = \\ &w_{in} f(y_1) + \sum_{t=2}^{T} w_{tr}^T f(y_t, y_{t-1}) + \sum_{t=1}^{T} w_{em}^T f(x_t, y_t) \end{aligned} \tag{4}$$

where w_{in}, w_{tr} and w_{em} are the linear models for assigning a score to the initial classes, transitions and emissions, respectively. Functions $f(y_1)$, $f(y_t, y_{t-1})$ and $f(x_t, y_t)$ are arbitrary, fixed "feature" functions of the measurements and the labels.

The generalized linear model in (4) is more suitable for discriminative training than the generative probabilistic model in (3). Notable discriminative approaches are conditional random fields (CRFs) (Lafferty et al., 2001) and structural SVM (Tsochantaridis et al., 2005). In particular, structural SVM has built a very strong reputation for experimental accuracy in NLP tasks (Joachims et al., 2009; Tang et al., 2013; Qu et al., 2014) and for this reason we exploit it in our NER pipeline.

Eventually, given a measurement sequence x in input, inference of the optimal label sequence can be obtained as:

$$\bar{y} = \underset{y}{\operatorname{argmax}}\, p(x, y) = \underset{y}{\operatorname{argmax}}(w^T \phi(x, y)) \tag{5}$$

This problem can be efficiently solved in $O(T)$ time by the Viterbi algorithm working in either the linear or logarithmic scale (Rabiner, 1989).

3.2.2 Structural SVM

From a supervised training set of sequences, $\{X, Y\} = \{x^i, y^i\}, i = 1 \dots N$, *structural SVM* finds the model's parameters, w, by minimizing the usual SVM trade-off between the hinge loss and an $L2$ regularizer (Tsochantaridis et al., 2005). Its learning objective can be expressed as:

$$\begin{aligned} &\underset{w,\xi}{\operatorname{argmin}} \ \frac{1}{2}\|w\|^2 + C\sum_{i=1}^{N}\xi^i \quad s.t. \\ &w^T\phi(x^i, y^i) - w^T\phi(x^i, y) \geq \Delta(y^i, y) - \xi^i, \\ &\qquad i = 1 \dots N, \ \ \forall y \in \mathcal{Y} \end{aligned} \tag{6}$$

In the objective function, the first term is the regularizer while the second term, $\sum_{i=1}^{N}\xi^i$, is the hinge loss, i.e. a convex upper bound over the total loss on the training set. Hyperparameter C is an arbitrary, positive coefficient that balances these two terms. In the constraints, $w^T\phi(x, y)$ computes the generalized linear score for a (x, y) pair. In the case of sequential labeling, such a score is given by Eq. (4). Eventually, $\Delta(y^i, y)$ is the loss function chosen to assess the loss over the training set.

For an NER task with M entity classes, each sequence of length T adds $(M + 1)^T$ constraints to (6). Due to their exponential number, exhaustive satisfaction of all constraints is infeasible. However, (Tsochantaridis et al., 2005) has shown that it is possible to find ϵ-correct solutions with a subset of the constraints of polynomial size consisting of only the "most violated" constraint for each sequence, i.e. the labeling with the highest sum of score and loss:

$$\begin{aligned} &\xi^i = \max_y(-w^T\phi(x^i, y^i) + w^T\phi(x^i, y) + \Delta(y^i, y)) \\ &\rightarrow \bar{y}^i = \underset{y}{\operatorname{argmax}}(w^T\phi(x^i, y) + \Delta(y^i, y)) \end{aligned} \tag{7}$$

This problem is commonly referred to as "loss-augmented inference" given its resemblance with the common inference of Eq. (5) and is the core of structural SVM. In the case of scores and losses that can be computed frame by frame (such as the 0-1 loss or the Hamming loss), the Viterbi algorithm with appropriate weights can still be used to compute the loss-augmented inference in $O(T)$ time.

4 Data Collection

In this section, we describe the collection and preprocessing of the Persian corpora. The datasets consist of 1) an unsupervised corpus, called PersoSentencesCorpus, that we use for the word embedding module and 2) a manually named-entity annotated data set of Persian sentences, called ArmanPersoNERCorpus, that we use for supervised classification. Alongside this publication, we release ArmanPersoNERCorpus[1] as the first ever publicly-available Persian NER dataset.

4.1 PersoSentencesCorpus

A very large corpus of documents covering a variety of contexts is required to populate an effective co-occurrence matrix. We fulfill this requirement by accumulating the following three datasets of Persian sentences:

- The *Leipzig corpora* [2] with 1,000,000 sentences from news crawling and 300,000 from Wikipedia.
- The *VOA*[3] news dataset with 277,000 sentences.
- The *Persian Dependency Treebank*[4] with 29,982 sentences (Rasooli et al., 2013).

The aggregated corpus, called PersoSentencesCorpus, holds more than 1.6 million sentences and seems of adequate size to train the co-occurrence matrix.

[1] http://poostchi.info/hanieh/NLP/ArmanPersoNERCorpus.txt
[2] http://corpora2.informatik.uni-leipzig.de/download.html
[3] http://www.ling.ohio-state.edu/~jonsafari/corpora/index.html\#persian
[4] http://dadegan.ir/en/perdt/

Entity type	**Person**	**Organization**	**Location**	**Facility**	**Event**	**Product**	**Other**
Number of Tokens (NT)	5,215	10,036	4,308	1,485	2,518	1,463	224,990
Percentage	2.08%	4.01%	1.72%	0.59%	1.00%	0.58%	89.99%
Number of Unique-Tokens (NUT)	1,829	1,290	832	548	556	634	15,677
Percentage (NUT/NT)	35.07%	12.85%	19.31%	36.90%	22.08%	43.33%	6.96%

Table 1: Class percentages in ArmanPersoNERCorpus.

4.2 ArmanPersoNERCorpus

To create an NE dataset, in collaboration with ArmanSoft[5], we have decided to manually annotate NEs in a subset of the **BijanKhan**[6] (Bijankhan et al., 2011) corpus which is the most-established tagged Persian corpus, yet lacking entity annotation. We selected the subset from news sentences since they are the most entity-rich. Before the annotation, a comprehensive manual was designed based on the definition of Sekine's extended named entities (Sekine, 2007) adapted to the Persian Language. The annotation task was led by an experienced lead annotator who instructed the front-end annotators (two native post-graduate students) and revised their annotations. The guidelines were very clear and we expected minimal subjectivity. We have verified this hypothesis in two ways: by a sample of 500 already annotated NEs chosen randomly, and by another sample of 500 already annotated NEs from the two most semantically-close classes (location and organization). Both samples were revised by three other, independent native annotators and the percentages of corrections have been only 1.8% and 1.9%, respectively.

All NEs have been annotated in IOB format. The annotated dataset, **ArmanPersoNERCorpus**, contains 250,015 tokens and 7,682 sentences (considering the full-stop as the sentence terminator). It can be used to train NER systems in future research on Persian NER, but it also offers an ideal test set for evaluation of NER systems trained on silver standards. The NEs are categorized into six classes: *person*, *organization* (such as banks, ministries, embassies, teams, nationalities, networks and publishers), *location* (such as cities, villages, rivers, seas, golfs, deserts and mountains), *facility* (such as schools, universities, research centers, airports, railways, bridges, roads, harbors, stations, hospitals, parks, zoos and cinemas), *product* (such as books, newspapers, TV shows, movies, airplanes, ships, cars, theories, laws, agreements and religion), and *event* (such as wars, earthquakes, national holidays, festivals and conferences); *other* are the remaining tokens. It is worth noting that annotation was not trivial since individual tokens have been categorized according to the context. For instance, *"Tokyo"* is a different type of entity in sentence *"$Tokyo_{loc}$ is a beautiful city"* versus sentence *"$London_{org}$ and $Tokyo_{org}$ sign flight agreement"*. Table 1 summarizes the number of tokens for each entity class in ArmanPersoNERCorpus.

Figure 2 shows a snapshot of the dataset together with an English transliteration of the tokens. Each line contains five tab-separated columns. In order from left to right, they are ez$\bar{a}$fe, POS-tag, inflexion, token and NER-tag. The first three columns are inherited from the BijanKhan corpus. Ez$\bar{a}$fe [7] is a grammatical particle in the Persian language that connects words of a phrase, usually noun-phrase, together. It is pronounced as an unstressed i vowel between the linked words, but generally not indicated in writing.

4.3 Text Normalization

As the preprocessing phase, the PersoSentencesCorpus has been normalized and tokenized following the approach proposed in (Feely et al., 2014) that suggests applying a pipeline of useful tools to deal with written Persian. The pipeline starts with PrePer (Seraji, 2013) which maps Arabic specific characters to their Persian Unicode equivalent. In addition, it replaces the full space between a word and its affix with a zero-width-non-joiner character. Then, a Farsi text normalizer (Feely, 2013) omits Arabic and Persian diacritics and unifies variant forms of some Persian characters to a single Unicode representation. Finally,

[5] http://armansoft.ir

[6] http://ece.ut.ac.ir/dbrg/bijankhan/

[7] https://en.wikipedia.org/wiki/Ezafe

Ezāfe	POS-tag	Inflexion	Token	NER-tag	Transliteration
O	N	N,SING,SURN	سید	B-PERS	Seyed
EZ	N	N,SING,PR,GEN	محمود	I-PERS	Mahmoud
O	N	N,SING,PR	محدث	I-PERS	Mohadess
EZ	N	N,SING,COM,GEN	مدیر	O	manager
EZ	N	N,SING,COM,GEN	اکتشاف	O	discovery
EZ	N	N,SING,COM,GEN	شرکت	B-ORG	Company
EZ	AJ	ADJ,SIM,GEN	ملی	I-ORG	National
EZ	N	N,SING,COM,GEN	نفت	I-ORG	Oil
O	N	N,SING,LOC,PR	ایران	I-ORG	Iranian
O	P	P	در	O	in
O	N	N,SING,COM	مصاحبه	O	interview
O	P	P	با	O	with
EZ	AJ	ADJ,SIM,GEN	واحد	B-ORG	Unit
EZ	AJ	ADJ,SIM,GEN	مرکزی	I-ORG	Central
O	N	N,SING,COM	خبر	I-ORG	News
O	P	P	با	O	with
EZ	N	N,SING,COM,GEN	اعلام	O	declaring
O	DET	DET	این	O	this
O	N	N,SING,COM	خبر	O	announcement
O	V	V,PA,SIM,POS,3	افزود	O	adds
O	PUNC	DELM	:	O	:
O	P	P	با	O	With
EZ	N	N,PL,COM,GEN	حفاریهای	O	diggings
O	AJ	ADJ,CMPR	بیشتر	O	more
O	P	P	در	O	in
EZ	N	N,SING,LOC,GEN	میدان	B-LOC	field
EZ	AJ	ADJ,SIM,GEN	نفتی	I-LOC	oil
O	N	N,SING,LOC,PR	چنگوله	I-LOC	Changuleh
O	N	N,SING,COM	انتظار	O	expectation
O	V	V,PRS,POS,4	داریم	O	have
EZ	N	N,PL,COM,GEN	ذخائر	O	reservoirs
O	DET	DET	این	O	In
O	N	N,SING,LOC	میدان	O	field
O	N	N,SING,COM	افزایش	O	increase
O	V	V,SUB,POS,3	یابد	O	will
O	PUNC	DELM	.	O	.

Figure 2: A snapshot of ArmanPersoNERCorpus.

	Entities													
	Person		**Organization**		**Location**		**Facility**		**Event**		**Product**		**Overall**	
Methods	MUC7	CoNLL	MUC7	CoNLL	MUC7	CoNLL	MUC7	CoNLL	MUC7	CoNLL	MUC7	CoNLL	MUC7	CoNLL
CRF	76.98	64.10	60.59	42.25	66.98	57.97	61.46	41.09	59.98	22.48	33.75	20.00	60.89	49.92
Jordan-RNN	79.13	72.13	67.31	57.28	69.90	62.70	63.49	51.92	62.30	39.79	49.50	**42.08**	68.53	60.52
SVM-HMM	**82.40**	**75.65**	**71.65**	**61.59**	**72.92**	**66.67**	**72.22**	**61.20**	**71.63**	**52.58**	**50.90**	41.37	**72.59**	**65.13**

Table 2: F_1 score comparison between three different classifiers based on MUC7 and CoNLL score functions for NER task on ArmanPersoNERCorpus. The F_1 score achieved by structural SVM is higher overall and for all classes but one, with the Jordan-RNN as the second best.

tokenization is performed by using three tokenizers in a cascade: the Farsi verb tokenizer of (Manshadi, 2013), SetPer (Seraji et al., 2012) and tok-tok (Dehdari, 2015).

5 Experiments

In this section, we report NER results based on the PersoSentencesCorpus and ArmanPersoNERCorpus datasets. The classification task is challenging given the much lower frequencies of the entity classes versus the non-entity class (*other*), as shown in Table 1. For this task, we have not used any of the additional linguistic information that is available from the dataset (such as POS tag, inflexion etc).

To calculate the co-occurrence matrix, C, we have used a context window of radius 5. The size of the dictionary, V, from the PersoSentencesCorpus is $|V| = 49,902$ and that of subset D is $D = 7,099$, obtained by selecting only the words with count greater than 15. The word embedding matrix $h(C)$ has been computed by heuristically setting $m = 300$. For classification, each word has been encoded as a 3-gram that includes the previous and following feature vectors. All the models used for classification share the same word embeddings.

For classification, we have compared the proposed SVM-HMM with a CRF and a deep learning approach based on the Jordan-RNN (Mesnil et al., 2013). For the SVM-HMM we have used structural SVM from (Joachims, 2008) with a Markov chain of order 3 and learning constant $C = 0.5$. The CRF is from the HCRF library (Morency et al., 2010) and is trained with an $L2$ regularizer of weight 100. The Jordan-RNN is a recurrent neural network from (Mesnil et al., 2013) trained with 100 hidden states and initialized using the same features vectors. All parameters were chosen by 3-fold cross-validation over a reasonable range of values. The indices for the three folds are available in the dataset to allow for future result comparison. We have also tried continuous bag of words (Mikolov et al., 2013), skip-grams (Mikolov et al., 2013) and GloVe (Pennington et al., 2014) as embeddings, and the Elman-RNN (Mesnil et al., 2013) as classifier, but results have proved generally less accurate.

Table 2 shows the comparison of the average MUC7 and CoNLL scores from the 3-fold cross-validation for the three classifiers. The MUC7 and CoNLL scores are F_1 values adapted to the NER task, with the CoNLL score generally stricter than MUC7 (Nadeau and Sekine, 2007). As shown in Table 2, the scores achieved by the SVM-HMM are higher overall and for all classes but one, with the Jordan-RNN as the second best. To verify statistical significance, we have also run a paired t-test over the results from the six individual classes and confirmed statistical significance of the differences even at $p = 0.02$. The relative ranking between SVM-HMM and the CRF is supported by similar results in the literature, including (Nguyen and Guo, 2007; Tang et al., 2013; Lei et al., 2014), showing that regularized minimum-risk classifiers tend to outperform equivalent models trained under maximum conditional likelihood. The relative ranking between SVM-HMM and the RNN is instead somehow in contrast with the recent results in the literature, and a possible explanation for it is the relatively small size of the dataset compared to the number of free parameters in the models. We plan future comparative experiments with larger corpora to further probe this assumption.

6 Conclusion

In this paper, we have presented and released ArmanPersoNERCorpus, the first manually-annotated Persian NE dataset, and proposed an NER pipeline for the Persian language. The main components

of the pipeline are word embedding by Hellinger PCA and classification by a structural SVM-HMM classifier. Experiments conducted over the ArmanPersoNERCorpus dataset have achieved interesting overall F_1 scores of 72.59 (MUC7) and 65.13 (CoNNL), higher than those of a CRF and a Jordan-RNN. The released dataset can be used for further development of Persian NER systems and for evaluation of systems trained on silver-standard corpora, and the achieved accuracy will provide a baseline for future comparisons.

References

Rami Al-Rfou, Vivek Kulkarni, Bryan Perozzi, and Steven Skiena. 2015. Polyglot-ner: Massive multilingual named entity recognition. In *Proceedings of 2015 SIAM International Conference on Data Mining*.

Maha Althobaiti, Udo Kruschwitz, and Massimo Poesio. 2015. Combining minimally-supervised methods for arabic named entity recognition. *TACL*, 3:243–255.

Mahmood Bijankhan, Javad Sheykhzadegan, Mohammad Bahrani, and Masood Ghayoomi. 2011. Lessons from building a persian written corpus: Peykare. *Language resources and evaluation*, 45(2):143–164.

Ronan Collobert, Jason Weston, Léon Bottou, Michael Karlen, Koray Kavukcuoglu, and Pavel Kuksa. 2011. Natural language processing (almost) from scratch. *J. Mach. Learn. Res.*, 12:2493–2537, November.

Jon Dehdari. 2015. A fast, simple, multilingual tokenizer. `https://github.com/jonsafari/tok-tok/`.

Weston Feely, Mehdi Manshadi, Robert E Frederking, and Lori S Levin. 2014. The cmu metal farsi nlp approach. In *Proceedings of the Ninth International Conference on Language Resources and Evaluation*, pages 4052–4055, Reykjavik, Iceland.

Weston Feely. 2013. Open-source dependency parser, part-of-speech-tagger, and text normalizer for farsi (persian). `https://github.com/wfeely/farsiNLPTools/`.

Jenny Rose Finkel, Trond Grenager, and Christopher Manning. 2005. Incorporating non-local information into information extraction systems by gibbs sampling. In *Proceedings of the 43nd Annual Meeting of the Association for Computational Linguistics*, pages 363–370.

Ralph Grishman and Beth Sundheim. 1996. Message understanding conference: A brief history. In *Proceedings of the 16th International Conference on Computational Linguistics (COLING)*, pages 466–471, Kopenhagen.

Thorsten Joachims, Thomas Hofmann, Yisong Yue, and Chun-Nam Yu. 2009. Predicting structured objects with support vector machines. *Communications of the ACM*, 52(11):97–104.

Thorsten Joachims. 2008. SVM$^{\text{hmm}}$: Sequence tagging with structural support vector machines. `https://www.cs.cornell.edu/people/tj/svm\_light/svm\_hmm.html/`.

Morteza Kolali Khormuji and Mehrnoosh Bazrafkan. 2014. Persian named entity recognition based with local filters. *International Journal of Computer Applications*, 100(4):1–6.

John D. Lafferty, Andrew McCallum, and Fernando C. N. Pereira. 2001. Conditional random fields: Probabilistic models for segmenting and labeling sequence data. In *Proceedings of the Eighteenth International Conference on Machine Learning*, ICML '01, pages 282–289, San Francisco, CA, USA. Morgan Kaufmann Publishers Inc.

Remi Lebret and Ronan Collobert. 2014. Word embedding through hellinger pca. In *14th Conference of the European Chapter of the Association for Computational Linguistics*, Gothenburg, Sweden.

Jianbo Lei, Buzhou Tang, Xueqin Lu, Kaihua Gao, Min Jiang, and Hua Xu. 2014. A comprehensive study of named entity recognition in chinese clinical text. *Journal of the American Medical Informatics Association*, 21:808–814.

Mehdi Manshadi. 2013. Farsi verb tokenizer. `https://github.com/mehdi-manshadi/Farsi-Verb-Tokenizer/`.

Grégoire Mesnil, Xiaodong He, Li Deng, and Yoshua Bengio. 2013. Investigation of recurrent-neural-network architectures and learning methods for spoken language understanding. In *Interspeech 2013*, August.

Grégoire Mesnil, Yann Dauphin, Kaisheng Yao, Yoshua Bengio, Li Deng, Dilek Hakkani-Tur, Xiaodong He, Larry Heck, Gokhan Tur, Dong Yu, and Geoffrey Zweig. 2015. Using recurrent neural networks for slot filling in spoken language understanding. *IEEE/ACM Transactions on Audio, Speech, and Language Processing*, March.

Tomas Mikolov, Ilya Sutskever, Kai Chen, Greg S Corrado, and Jeff Dean. 2013. Distributed representations of words and phrases and their compositionality. In *Advances in neural information processing systems*, pages 3111–3119.

Louis-Philippe Morency, C. Mario Christoudias, Ariadna Quattoni, Hugues Salamin, Giota Stratou, and Sybor Wang. 2010. Hidden-state conditional random field library. `http://multicomp.ict.usc.edu/?p=790`.

David Nadeau and Satoshi Sekine. 2007. A survey of named entity recognition and classification. *Linguisticae Investigationes*, 30(1):3–26, January. Publisher: John Benjamins Publishing Company.

Nam Nguyen and Yunsong Guo. 2007. Comparisons of sequence labeling algorithms and extensions. In *Proceedings of the 24th International Conference on Machine Learning*, ICML '07, pages 681–688, New York, NY, USA. ACM.

Joel Nothman, Nicky Ringland, Will Radford, Tara Murphy, and James R. Curran. 2013. Learning multilingual named entity recognition from wikipedia. *Artif. Intell.*, 194:151–175, January.

Jeffrey Pennington, Richard Socher, and Christopher D. Manning. 2014. Glove: Global vectors for word representation. `http://nlp.stanford.edu/projects/glove/`.

Lizhen Qu, Yi Zhang, Rui Wang, Lili Jiang, Rainer Gemulla, and Gerhard Weikum. 2014. Senti-lssvm: Sentiment-oriented multi-relation extraction with latent structural SVM. *TACL*, 2:155–168.

L.R. Rabiner. 1989. A tutorial on hidden Markov models and selected applications in speech recognition. *IEEE Proc.*, 77:257–286.

Mohammad Sadegh Rasooli, Manouchehr Kouhestani, and Amirsaeid Moloodi. 2013. Development of a persian syntactic dependency treebank. In *Proceedings of the 2013 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, pages 306–314, Atlanta, Georgia, June. Association for Computational Linguistics.

Satoshi Sekine. 2007. The definition of sekines extended named entities. `http://nlp.cs.nyu.edu/ene/version7_1_0Beng.html`. New York University.

Mojgan Seraji, Megyesi Beta, and Nivre Joakim. 2012. A basic language resource kit for persian. In *Proceedings of the 8th International Conference on Language Resources and Evaluation*, pages 2245–2252, Istanbul, Turkey.

Mojgan Seraji. 2013. Preper: A pre-processor for persian. In *Proceedings of Fifth International Conference on Iranian Linguistics*, Bamberg, Germany.

Mehrnoush Shamsfard. 2011. Challenges and open problems in persian text processing. *Proceedings of LTC*, 11.

Buzhou Tang, Hongxin Cao, Yonghui Wu, Min Jiang, and Hua Xu. 2013. Recognizing clinical entities in hospital discharge summaries using structural support vector machines with word representation features. *BMC Medical Informatics and Decision Making*, 13(SUPPL1).

Erik F. Tjong Kim Sang and Fien De Meulder. 2003. Introduction to the conll-2003 shared task: Language-independent named entity recognition. In *Proceedings of the Seventh Conference on Natural Language Learning at HLT-NAACL 2003 - Volume 4*, CONLL '03, pages 142–147, Stroudsburg, PA, USA. Association for Computational Linguistics.

I. Tsochantaridis, T. Joachims, T. Hofmann, and Y. Altun. 2005. Large margin methods for structured and interdependent output variables. *JMLR*, 6:1453–1484.

GuoDong Zhou and Jian Su. 2002. Named entity recognition using an hmm-based chunk tagger. In *Proceedings of the 40th Annual Meeting on Association for Computational Linguistics*, ACL '02, pages 473–480, Stroudsburg, PA, USA. Association for Computational Linguistics.

COLING 2016

The 26th International Conference on Computational Linguistics

Proceedings of COLING 2016: Technical Papers

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Preface: General Chair

Welcome to COLING 2016 – the 26th International Conference on Computational Linguistics — held in Osaka, Japan! It is the third COLING in Japan after Tokyo (1980) and Kyoto (1994). It is a special pleasure for me to be General Chair (10 years after chairing the joint COLING-ACL 2006 in Sydney) of a COLING held in Japan, a country I love.

COLING is organised under the auspices of the International Committee on Computational Linguistics (ICCL, http://nlp.shef.ac.uk/iccl/index.html). ICCL is a very special committee, with no fixed rules and no funding, whose only function is to make sure that a COLING appears every two years and that it is a good and friendly conference.

I have participated to many COLINGs, since the one in Pisa in 1973. It was a COLING without email! I still remember when Antonio Zampolli (Local chair) received by Hans Karlgren (Program chair) a sketch of the program written by hand, almost unreadable, and asked me (very young at the time) to interpret it. I have seen COLINGs where submissions arrived on paper and many packages were sent around the world to area chairs, to be sent to reviewers, and all the results back again by normal mail. It seems impossible now.

COLING has changed over the years, together with the changes in our field. But it has always been important for ICCL to maintain the COLING "spirit": we always wanted COLING to be an inclusive and broad conference. We also want to underline that in our field "language" is important and we therefore pay special attention to having papers and workshops focusing on understanding language properties and complexities. Moreover, for us the social part of the conference is as important as the scientific one.

An outstanding competent and dedicated team has worked for the organisation of COLING 2016. I wish to warmly thank, also on behalf of ICCL, all the various Chairs, too many to mention them all here, for the wonderful work they have done. It has been a pleasure and a privilege for me to work together with all of them: they made my work as General chair very easy. But I owe a special thanks to Yuji Matsumoto and Rashmi Prasad, Program chairs, for their hard work in managing so smoothly an impressive number of submissions, many more than we expected. And I wish to express my deepest gratitude to the Local chairs – Eiichiro Sumita, Takenobu Tokunaga and Sadao Kurohashi – who have done a fantastic work with great dedication in all the various phases of the conference organisation, always keeping everything under control. Not an easy task, as I know too well!

I also want to thank the generosity of all the sponsors for their great support to COLING.

Last but not least, I thank the colleagues (so many) who submitted their work to COLING, the organisers of Workshops and Tutorials, the participants (more than 900 at the time of writing) and the many students among them. It is important that many young researchers can attend COLINGs. They show the great interest of our community in COLING.

I hope that you benefit not only from the scientific programme but also from the social parts of COLING. I hope you get from this COLING both new exciting ideas and also new friends.

Enjoy COLING 2016 in Japan!

Nicoletta Calzolari (ICCL, ILC-CNR and ELRA)

Preface: Program Chairs

It is with great pleasure that we welcome you to the 26th International Conference on Computational Linguistics (COLING 2016) in Osaka, Japan! COLING covers a broad spectrum of technical areas related to natural language and computation. This year, we received 1,039 valid submissions (from a total of 1127 submissions), of which we accepted 337 papers (32.4% acceptance rate). 134 papers were selected for oral presentation and 203 papers for poster presentation. No distinction is made in these proceedings between papers presented orally or as a poster, as they were not distinguished qualitatively but rather by judging the best mode for delivering the paper content.

To effectively cover the broad spectrum of topics included in the conference, we have 18 thematic areas, each chaired by two or more area chairs. We are extremely grateful to the area chairs, who led and monitored the reviewing and reviewer discussions, and sent us detailed recommendation reports resulting from the reviewing process, including best paper recommendations. We cannot thank enough the over 800 reviewers who have put in the requisite time and effort to carefully assess the very large number of submissions we received this year. Their dedication and commitment, and willingness to work with us even when there were tight time constraints, made the entire task proceed much more smoothly than we had hoped! Almost all papers were reviewed by at least three reviewers and we are very happy with the highly strong set of papers accepted for presentation. We thank all authors for their submissions describing their very commendable research, and hope that authors of papers we could not accept have nevertheless benefited from the feedback they received from reviewers.

We have structured the accepted submissions into ten sessions, with multiple thematic areas included in parallel, either for oral presentation or poster presentation. Only one session – the first session – does not have a parallel poster session. We are delighted to have four invited speakers to the conference: Joakim Nivre from Uppsala University: "Universal Dependencies – Dubious Linguistics and Crappy Parsing?"; Reiko Mazuka from RIKEN Brain Science Institute & Duke University: "Getting the Input Right: Refining our Understanding of What Children Hear"; Dina Demner-Fushman from the U.S. National Library of Medicine: "NLP to support clinical tasks and decisions", and Simone Teufel from University of Cambridge: "A Look at Computational Argumentation and Summarisation from a Text-Understanding Perspective".

We are extremely grateful to the members of the best paper committee, Tim Baldwin, Vincent Ng, and Hinrich Schütze, who agreed to put in extra time to select the two best papers at the conference. Best paper nominations were collected in a bottom-up fashion, with reviewers first providing their recommendation for each paper, and area chairs then collecting the positive recommendations, and upon their own assessment of the corresponding reviews and papers, selecting some or all to be forwarded to the PC chairs. PC chairs then invited the three experts to form a committee (chaired by the PC chairs) to select the two best papers from this set of nominated papers.

We would like to thank the many members of the organizing committee who have helped us in crucial ways at various stages of organizing the technical program – the General Chair, Nicoletta Calzolari; the Local Chairs, Eiichiro Sumita, Takenobu Tokunaga and Sadao Kurohashi; the Publication Chairs, Hitoshi Isahara and Masao Utiyama; the Publicity Chairs, Srinivas Bangalore, Dekai Wu and Antonio Branco; and the Web Master Akifumi Yoshimoto. Our special thanks go to Swapna Somasundaran for her voluntary help to recruit additional reviewers to handle the much larger than expected submissions to the conference. Last but not the least, we are grateful to the softconf manager, Rich Gerber, for his continuous help with our various questions and needs.

We hope that you enjoy the conference!

Yuji Matsumoto, Nara Institute of Science and Technology, Japan
Rashmi Prasad, University of Wisconsin-Milwaukee, U.S.A.

Preface: Local Chairs

Welcome to the COLING 2016!

It is a pleasure to welcome you to COLING 2016 organized by the Japanese Association of Natural Language Processing (ANLP) in Osaka. It has been 22 years since Japan last held the conference. While we are meeting here to discuss NLP, there is no substitute for personal contact. Therefore, we have arranged breaks, a reception, an excursion and a delightful banquet to facilitate discussion, collaboration and making connections. We hope and the modern conference venue together with the ambience of western Japan including Osaka, Nara and Kyoto (famous for their nature, culture, history, and food), help to make this an enjoyable experience for all. We hope the conference will result in accelerated growth of NLP.

Organizing a conference always takes a lot of work, and fortunately, we have experienced people from all around the world in attendance at the COLING 2016 site. It is both an honor and a great pleasure to work with them, and we thank them gratefully.

Since the proposal to host COLING was accepted by ICCL in 2014, our world has experienced some drastic changes. Under unfavorable economic conditions in Japan and considering the distance from Europe and America, we had to make a very conservative financial plan for the conference. The sponsorship chairs worked very hard and collected 33 sponsors, which is considerably more than in previous COLINGs.

This year's conference has attracted a huge number of submissions and has a high level of participation, reflecting the ongoing dynamism in artificial intelligence around the globe. We were both overwhelmed by the numbers of visa applications we had to handle, and at the same time delighted and excited by the tremendous response.

We'd like to end by reporting two special features of COLING 2016: (1) COLING will assist student participants with registration subsidies. Successful applicants for the Student Support Program will receive all-inclusive free registration; (2) the collocation of the first international symposium for young researchers working on Natural Language Processing (YRSNLP) as an official satellite event at COLING 2016.

Welcome, and enjoy the conference!

Eiichiro SUMITA, Takenobu TOKUNAGA, and Sadao KUROHASHI

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Invited talk 1

Universal Dependencies – Dubious Linguistics and Crappy Parsing?

Joakim Nivre (Uppsala University)

Universal Dependencies is a framework for cross-linguistically consistent treebank annotation that has so far been applied to over 50 languages. It was developed primarily to support multilingual parsing research, but the resources have proven useful for a wide range of studies that were not foreseen originally, including research on language typology. A basic design principle in Universal Dependencies is to give priority to grammatical relations between content words, which are more likely to be parallel across languages, and to treat function words essentially as features of content words. This principle has been criticized both for being incompatible with theoretical linguistics, which tend to treat function words as syntactic heads, and for being suboptimal as a representation for dependency parsing, where higher accuracy is often observed with function words as heads. I will argue that both of these criticisms rest on a misinterpretation of the syntactic representations, and I will show that an alternative interpretation is compatible with both sound linguistics and improved parsing technology.

Invited talk 2

Getting the Input Right: Refining our Understanding of What Children Hear

Reiko Mazuka (RIKEN Brain Science Institute & Duke University)

As models for language learning become increasingly sophisticated, it is essential to pay close attention to the purported input received by learners. This talk presents two examples of phonological input for which a failure to account for relevant factors has led to misleading conclusions. A fully annotated dataset of infant-directed speech is now allowing a more refined analysis of what children actually hear. The first example concerns vowel-duration contrasts (long vs. short) in Japanese. One previous study, working under the assumption that long and short vowels occurred with equal frequency, concluded that the distinction could be learned by a simple distributional model. Our dataset, however, reveals that (a) in reality over 90% of vowels in Japanese are short, and (b) the distribution of long vowel duration is entirely encompassed within that of short vowels. The second example concerns the widely accepted claim that when adults speak to infants (infant-directed speech, IDS), they speak with a slower speech rate than when speaking to adults (adult-directed speech, ADS). Studies supporting this conclusion, however, have consistently failed to account for the fact that IDS utterances are shorter than those of ADS. Our dataset differentiates between utterance-internal speech rate and utterance-final lengthening, and finds taken separately, these values almost identical between IDS and ADS. As it turns out, IDS appeared to have a slower overall rate only because of the greater frequency of utterance-final segments.

Invited talk 3

NLP to support clinical tasks and decisions

Dina Demner-Fushman (U.S. National Library of Medicine)

Clinical decision support (CDS) provides clinicians and patients with information needed to enhance health and health care. Clinical NLP – natural language processing methods to support healthcare by operationalizing clinical information contained in clinical narrative – is an integral part of CDS. Clinical NLP has started in the early 1960s, with several successful applications now integrated in daily care. I will first discuss the successful applications that are already positively impacting clinical practice, as well as publicly available resources, including those developed by our group. Consumer language understanding is an equally important and rapidly evolving part of CDS. In the second part of the talk, I will present our work in understanding consumer health questions. I will conclude with the challenges and opportunities to contribute to these fascinating research areas that have practical implications for our health.

Invited talk 4

A Look at Computational Argumentation and Summarisation from a Text-Understanding Perspective

Simone Teufel (University of Cambridge)

In the past five years, computational argumentation has emerged as a new, active research field. This field studies all aspects of analysing and generating human argumentation, including argument mining, supportive debating technologies, logical representation of arguments, models of reasoning, and the connection of discourse processing and argumentation. As somebody who is mainly interested in the text-understanding challenges of computational argumentation, I think this new field has the potential to advance (and provide means of evaluating) the text-understanding capabilities of today's NLP systems.

When humans construct an argument in order to convince others, how do they order and structure the information they want to convey? I will argue that whatever principles are at work, they are almost identical to those needed when summarising a text. Amongst the relations of particular interest are entailment, causal and rhetorical relationships. I will give an overview of currently available (text understanding-based) analysis methods that can inform our understanding of these principles, and I will also say a few words about a proposition-based approach to summarisation we have developed at Cambridge University that has the potential to contribute insights to computational argumentation.

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Quynh Ngoc Thi Do, Steven Bethard and Marie-Francine Moens

Predictability of Distributional Semantics in Derivational Word Formation
Sebastian Padó, Aurélie Herbelot, Max Kisselew and Jan Šnajder

10:30–12:30 **Session 5-B: Computational Psycholinguistics and Linguistic Issues in NLP II**

Survey on the Use of Typological Information in Natural Language Processing
Helen O'Horan, Yevgeni Berzak, Ivan Vulic, Roi Reichart and Anna Korhonen

From phonemes to images: levels of representation in a recurrent neural model of visually-grounded language learning
Lieke Gelderloos and Grzegorz Chrupała

Linguistic features for Hindi light verb construction identification
Ashwini Vaidya, Sumeet Agarwal and Martha Palmer

Cross-lingual Transfer of Correlations between Parts of Speech and Gaze Features
Maria Barrett, Frank Keller and Anders Søgaard

10:30–12:30 Session 5-C: Lexical Semantics, Ontologies & Paraphrasing, Textual Entailment I

Sentence Similarity Learning by Lexical Decomposition and Composition
Zhiguo Wang, Haitao Mi and Abraham Ittycheriah

Chinese Hypernym-Hyponym Extraction from User Generated Categories
Chengyu Wang and Xiaofeng He

Dynamic Generative model for Diachronic Sense Emergence Detection
Martin Emms and Arun kumar Jayapal

Semi-supervised Word Sense Disambiguation with Neural Models
Dayu Yuan, Julian Richardson, Ryan Doherty, Colin Evans and Eric Altendorf

10:30–12:30 Session 5-D: Machine Translation I

Fast Gated Neural Domain Adaptation: Language Model as a Case Study
Jian Zhang, Xiaofeng Wu, Andy Way and Qun Liu

Machine Translation Evaluation for Arabic using Morphologically-enriched Embeddings
Francisco Guzmán, Houda Bouamor, Ramy Baly and Nizar Habash

Ensemble Learning for Multi-Source Neural Machine Translation
Ekaterina Garmash and Christof Monz

Phrase-based Machine Translation using Multiple Preordering Candidates
Yusuke Oda, Taku Kudo, Tetsuji Nakagawa and Taro Watanabe

10:30–12:30 Session 5-P: Poster Session 4

Information Retrieval, Information Extraction, Question Answering

Hand in Glove: Deep Feature Fusion Network Architectures for Answer Quality Prediction in Community Question Answering
Sai Praneeth Suggu, Kushwanth Naga Goutham, Manoj K. Chinnakotla and Manish Shrivastava

Learning Event Expressions via Bilingual Structure Projection
Fangyuan Li, Ruihong Huang, Deyi Xiong and Min Zhang

Global Inference to Chinese Temporal Relation Extraction
Peifeng Li, Qiaoming Zhu, Guodong Zhou and Hongling Wang

Improved relation classification by deep recurrent neural networks with data augmentation
Yan Xu, Ran Jia, Lili Mou, Ge Li, Yunchuan Chen, Yangyang Lu and Zhi Jin

Relation Extraction with Multi-instance Multi-label Convolutional Neural Networks
Xiaotian Jiang, Quan Wang, Peng Li and Bin Wang

Named Entity Disambiguation for little known referents: a topic-based approach
Andrea Glaser and Jonas Kuhn

Natural Language Generation, Summarization

Building RDF Content for Data-to-Text Generation
Laura Perez-Beltrachini, Rania SAYED and Claire Gardent

Parallel Sentence Compression
Julia Ive and François Yvon

An Unsupervised Multi-Document Summarization Framework Based on Neural Document Model
Shulei Ma, Zhi-Hong Deng and Yunlun Yang

From OpenCCG to AI Planning: Detecting Infeasible Edges in Sentence Generation
Maximilian Schwenger, Alvaro Torralba, Joerg Hoffmann, David M. Howcroft and Vera Demberg

The Next Step for Multi-Document Summarization: A Heterogeneous Multi-Genre Corpus Built with a Novel Construction Approach
Markus Zopf, Maxime Peyrard and Judith Eckle-Kohler

Sentiment Analysis and Computational Argumentation

SentiHood: Targeted Aspect Based Sentiment Analysis Dataset for Urban Neighbourhoods
Marzieh Saeidi, Guillaume Bouchard, Maria Liakata and Sebastian Riedel

On the Impact of Seed Words on Sentiment Polarity Lexicon Induction
Dame Jovanoski, Veno Pachovski and Preslav Nakov

Evaluating Argumentative and Narrative Essays using Graphs
Swapna Somasundaran, Brian Riordan, Binod Gyawali and Su-Youn Yoon

Selective Co-occurrences for Word-Emotion Association
Ameeta Agrawal and Aijun An

Weighted Neural Bag-of-n-grams Model: New Baselines for Text Classification
Bofang Li, Zhe Zhao, Tao Liu, Puwei Wang and Xiaoyong Du

A Deeper Look into Sarcastic Tweets Using Deep Convolutional Neural Networks
Soujanya Poria, Erik Cambria, Devamanyu Hazarika and Prateek Vij

Exploring Distributional Representations and Machine Translation for Aspect-based Cross-lingual Sentiment Classification.
Jeremy Barnes, Patrik Lambert and Toni Badia

A Bilingual Attention Network for Code-switched Emotion Prediction
Zhongqing Wang, Yue Zhang, Sophia Lee, Shoushan Li and Guodong Zhou

UTCNN: a Deep Learning Model of Stance Classification on Social Media Text
Wei-Fan Chen and Lun-Wei Ku

Computational Psycholinguistics

The Role of Intrinsic Motivation in Artificial Language Emergence: a Case Study on Colour
Miquel Cornudella, Thierry Poibeau and Remi van Trijp

Predicting the Evocation Relation between Lexicalized Concepts
Yoshihiko Hayashi

Collecting and Exploring Everyday Language for Predicting Psycholinguistic Properties of Words
Gustavo Paetzold and Lucia Specia

Applications

Using Argument Mining to Assess the Argumentation Quality of Essays
Henning Wachsmuth, Khalid Al Khatib and Benno Stein

Grammatical Templates: Improving Text Difficulty Evaluation for Language Learners
Shuhan Wang and Erik Andersen

Still not there? Comparing Traditional Sequence-to-Sequence Models to Encoder-Decoder Neural Networks on Monotone String Translation Tasks
Carsten Schnober, Steffen Eger, Erik-Lân Do Dinh and Iryna Gurevych

12:30–14:00 ***Lunch break***

14:00–16:00 Session 6-A: Information Retrieval, Information Extraction, Question Answering I

Towards Time-Aware Knowledge Graph Completion
Tingsong Jiang, Tianyu Liu, Tao Ge, Lei Sha, Baobao Chang, Sujian Li and Zhifang Sui

Learning to Weight Translations using Ordinal Linear Regression and Query-generated Training Data for Ad-hoc Retrieval with Long Queries
Javid Dadashkarimi, Masoud Jalili Sabet and Azadeh Shakery

Neural Attention for Learning to Rank Questions in Community Question Answering
Salvatore Romeo, Giovanni Da San Martino, Alberto Barrón-Cedeño, Alessandro Moschitti, Yonatan Belinkov, Wei-Ning Hsu, Yu Zhang, Mitra Mohtarami and James Glass

Simple Question Answering by Attentive Convolutional Neural Network
Wenpeng Yin, Mo Yu, Bing Xiang, Bowen Zhou and Hinrich Schütze

14:00–16:00 Session 6-B: Machine Learning for NLP II

Recurrent Dropout without Memory Loss
Stanislau Semeniuta, Aliaksei Severyn and Erhardt Barth

Modeling topic dependencies in semantically coherent text spans with copulas
Georgios Balikas, Hesam Amoualian, Marianne Clausel, Eric Gaussier and Massih R Amini

Consensus Attention-based Neural Networks for Chinese Reading Comprehension
Yiming Cui, Ting Liu, Zhipeng Chen, Shijin Wang and Guoping Hu

Semantic Annotation Aggregation with Conditional Crowdsourcing Models and Word Embeddings
Paul Felt, Eric Ringger and Kevin Seppi

14:00–16:00 Session 6-C: Machine Translation II

Interactive-Predictive Machine Translation based on Syntactic Constraints of Prefix
Na Ye, Guiping Zhang and Dongfeng Cai

Topic-Informed Neural Machine Translation
Jian Zhang, Liangyou Li, Andy Way and Qun Liu

A Distribution-based Model to Learn Bilingual Word Embeddings
Hailong Cao, Tiejun Zhao, Shu ZHANG and Yao Meng

Pre-Translation for Neural Machine Translation
Jan Niehues, Eunah Cho, Thanh-Le Ha and Alex Waibel

14:00–16:00 Session 6-D: Semantic Processing, Distributional Semantics, Compositionality II

Direct vs. indirect evaluation of distributional thesauri
Vincent Claveau and Ewa Kijak

D-GloVe: A Feasible Least Squares Model for Estimating Word Embedding Densities
Shoaib Jameel and Steven Schockaert

Predicting human similarity judgments with distributional models: The value of word associations.
Simon De Deyne, Amy Perfors and Daniel J Navarro

Distributional Hypernym Generation by Jointly Learning Clusters and Projections
Josuke Yamane, Tomoya Takatani, Hitoshi Yamada, Makoto Miwa and Yutaka Sasaki

14:00–16:00 Session 6-P: Poster Session 5

Discourse Relations, Coreference, Pragmatics

Incremental Fine-grained Information Status Classification Using Attention-based LSTMs
Yufang Hou

Detection, Disambiguation and Argument Identification of Discourse Connectives in Chinese Discourse Parsing
Yong-Siang Shih and Hsin-Hsi Chen

Multi-view and multi-task training of RST discourse parsers
Chloé Braud, Barbara Plank and Anders Søgaard

Implicit Discourse Relation Recognition with Context-aware Character-enhanced Embeddings
Lianhui Qin, Zhisong Zhang and Hai Zhao

Measuring Non-cooperation in Dialogue
Brian Plüss and Paul Piwek

Representation and Learning of Temporal Relations
Leon Derczynski

Revisiting the Evaluation for Cross Document Event Coreference
Shyam Upadhyay, Nitish Gupta, Christos Christodoulopoulos and Dan Roth

Modeling Discourse Segments in Lyrics Using Repeated Patterns
Kento Watanabe, Yuichiroh Matsubayashi, Naho Orita, Naoaki Okazaki, Kentaro Inui, Satoru Fukayama, Tomoyasu Nakano, Jordan Smith and Masataka Goto

Dialog Processing and Dialog Systems, Multimodal Interfaces

Multi-level Gated Recurrent Neural Network for dialog act classification
Wei Li and Yunfang Wu

Multimodal Mood Classification - A Case Study of Differences in Hindi and Western Songs
Braja Gopal Patra, Dipankar Das and Sivaji Bandyopadhyay

Detecting Context Dependent Messages in a Conversational Environment
Chaozhuo Li, Yu Wu, Wei Wu, Chen Xing, Zhoujun Li and Ming Zhou

Joint Inference for Mode Identification in Tutorial Dialogues
Deepak Venugopal and Vasile Rus

Dialogue Act Classification in Domain-Independent Conversations Using a Deep Recurrent Neural Network
Hamed Khanpour, Nishitha Guntakandla and Rodney Nielsen

Non-sentential Question Resolution using Sequence to Sequence Learning
Vineet Kumar and Sachindra Joshi

Context-aware Natural Language Generation for Spoken Dialogue Systems
Hao Zhou, Minlie Huang and xiaoyan zhu

Speech Recognition, Text-To-Speech, Spoken Language Understanding

Weakly-supervised text-to-speech alignment confidence measure
Guillaume Serrière, Christophe Cerisara, Dominique Fohr and Odile Mella

Domainless Adaptation by Constrained Decoding on a Schema Lattice
Young-Bum Kim, Karl Stratos and Ruhi Sarikaya

Sub-Word Similarity based Search for Embeddings: Inducing Rare-Word Embeddings for Word Similarity Tasks and Language Modelling
Mittul Singh, Clayton Greenberg, Youssef Oualil and Dietrich Klakow

Applications

Semi-automatic Detection of Cross-lingual Marketing Blunders based on Pragmatic Label Propagation in Wiktionary
Christian M. Meyer, Judith Eckle-Kohler and Iryna Gurevych

Ambient Search: A Document Retrieval System for Speech Streams
Benjamin Milde, Jonas Wacker, Stefan Radomski, Max Mühlhäuser and Chris Biemann

Semi-supervised Gender Classification with Joint Textual and Social Modeling
Shoushan Li, Bin Dai, Zhengxian Gong and Guodong Zhou

Predicting proficiency levels in learner writings by transferring a linguistic complexity model from expert-written coursebooks
Ildikó Pilán, Elena Volodina and Torsten Zesch

User Classification with Multiple Textual Perspectives
Dong Zhang, Shoushan Li, Hongling Wang and Guodong Zhou

Says Who…? Identification of Expert versus Layman Critics' Reviews of Documentary Films
Ming Jiang and Jana Diesner

Knowledge-Driven Event Embedding for Stock Prediction
Xiao Ding, Yue Zhang, Ting Liu and Junwen Duan

Distributed Representations for Building Profiles of Users and Items from Text Reviews
Wenliang Chen, Zhenjie Zhang, Zhenghua Li and Min Zhang

16:00–16:30 ***coffee break***

16:30–18:00 Session 7-A: Machine Translation III

Improving Statistical Machine Translation with Selectional Preferences
Haiqing Tang, Deyi Xiong, Min Zhang and Zhengxian Gong

Hierarchical Permutation Complexity for Word Order Evaluation
Miloš Stanojević and Khalil Sima'an

Interactive Attention for Neural Machine Translation
Fandong Meng, Zhengdong Lu, Hang Li and Qun Liu

16:30–18:00 Session 7-B: Applications IV

Get Semantic With Me! The Usefulness of Different Feature Types for Short-Answer Grading
Ulrike Pado

Automatically Processing Tweets from Gang-Involved Youth: Towards Detecting Loss and Aggression
Terra Blevins, Robert Kwiatkowski, Jamie MacBeth, Kathleen McKeown, Desmond Patton and Owen Rambow

Content-based Influence Modeling for Opinion Behavior Prediction
Chengyao Chen, Zhitao Wang, Yu Lei and Wenjie Li

16:30–18:00 Session 7-C: Computational Psycholinguistics and Linguistic Issues in NLP III

Data-driven learning of symbolic constraints for a log-linear model in a phonological setting
Gabriel Doyle and Roger Levy

Chinese Tense Labelling and Causal Analysis
Hen-Hsen Huang, Chang-Rui Yang and Hsin-Hsi Chen

Exploring Topic Discriminating Power of Words in Latent Dirichlet Allocation
Yang Kai, Cai Yi, Chen Zhenhong, Leung Ho-fung and LAU Raymond

16:30–18:00 Session 7-D: Lexical Semantics, Ontologies & Paraphrasing, Textual Entailment II

Textual Entailment with Structured Attentions and Composition
Kai Zhao, Liang Huang and Mingbo Ma

plWordNet 3.0 – a Comprehensive Lexical-Semantic Resource
Marek Maziarz, Maciej Piasecki, Ewa Rudnicka, Stan Szpakowicz and Paweł Kędzia

Time-Independent and Language-Independent Extraction of Multiword Expressions From Twitter
Nikhil Londhe, Rohini Srihari and Vishrawas Gopalakrishnan

16:30–18:00 Session 7-P: Poster Session 6

Information Retrieval, Information Extraction, Question Answering

Incremental Global Event Extraction
Alex Judea and Michael Strube

Hierarchical Memory Networks for Answer Selection on Unknown Words
jiaming xu, Jing Shi, Yiqun Yao, Suncong Zheng, Bo Xu and Bo Xu

Revisiting Taxonomy Induction over Wikipedia
Amit Gupta, Francesco Piccinno, Mikhail Kozhevnikov, Marius Pasca and Daniele Pighin

Joint Learning of Local and Global Features for Entity Linking via Neural Networks
Thien Huu Nguyen, Nicolas Fauceglia, Mariano Rodriguez Muro, Oktie Hassanzadeh, Alfio Massimiliano Gliozzo and Mohammad Sadoghi

Structured Aspect Extraction
Omer Gunes, Tim Furche and Giorgio Orsi

Robust Text Classification for Sparsely Labelled Data Using Multi-level Embeddings
Simon Baker, Douwe Kiela and Anna Korhonen

Mathematical Information Retrieval based on Type Embeddings and Query Expansion
Yiannos Stathopoulos and Simone Teufel

Text Retrieval by Term Co-occurrences in a Query-based Vector Space
Eriks Sneiders

Pairwise Relation Classification with Mirror Instances and a Combined Convolutional Neural Network
Jianfei Yu and Jing Jiang

FastHybrid: A Hybrid Model for Efficient Answer Selection
Lidan Wang, Ming Tan and Jiawei Han

Extracting Spatial Entities and Relations in Korean Text
Bogyum Kim and Jae Sung Lee

Hybrid Question Answering over Knowledge Base and Free Text
kun xu, Yansong Feng, Songfang Huang and Dongyan Zhao

Improved Word Embeddings with Implicit Structure Information
Jie Shen and Cong Liu

Sentiment Analysis, Computational Argumentation

Word Embeddings and Convolutional Neural Network for Arabic Sentiment Classification
Abdelghani Dahou, Shengwu Xiong, Junwei Zhou, Mohamed Houcine Haddoud and Pengfei Duan

Combination of Convolutional and Recurrent Neural Network for Sentiment Analysis of Short Texts
Xingyou Wang, Weijie Jiang and Zhiyong Luo

Stance Classification in Rumours as a Sequential Task Exploiting the Tree Structure of Social Media Conversations
Arkaitz Zubiaga, Elena Kochkina, Maria Liakata, Rob Procter and Michal Lukasik

Tweet Sarcasm Detection Using Deep Neural Network
Meishan Zhang, Yue Zhang and Guohong Fu

Agreement and Disagreement: Comparison of Points of View in the Political Domain
Stefano Menini and Sara Tonelli

Targeted Sentiment to Understand Student Comments
Charles Welch and Rada Mihalcea

Thursday, December 15, 2016 (continued)

Towards Sub-Word Level Compositions for Sentiment Analysis of Hindi-English Code Mixed Text
Aditya Joshi, Ameya Prabhu, Manish Shrivastava and Vasudeva Varma

Distance Metric Learning for Aspect Phrase Grouping
Shufeng Xiong, Yue Zhang, Donghong JI and Yinxia Lou

Friday, December 16, 2016

09:00–10:00 Invited talk 4: Simone Teufel (University of Cambridge)

10:00–10:30 ***coffee break***

10:30–12:30 Session 8-A: Information Retrieval, Information Extraction, Question Answering II

Constraint-Based Question Answering with Knowledge Graph
Junwei Bao, Nan Duan, Zhao Yan, Ming Zhou and Tiejun Zhao

Selecting Sentences versus Selecting Tree Constituents for Automatic Question Ranking
Alberto Barrón-Cedeño, Giovanni Da San Martino, Salvatore Romeo and Alessandro Moschitti

Attention-Based Convolutional Neural Network for Semantic Relation Extraction
yatian shen and Xuanjing Huang

Table Filling Multi-Task Recurrent Neural Network for Joint Entity and Relation Extraction
Pankaj Gupta, Hinrich Schütze and Bernt Andrassy

10:30–12:30 Session 8-B: Machine Translation IV

Bilingual Autoencoders with Global Descriptors for Modeling Parallel Sentences
Biao Zhang, Deyi Xiong, jinsong su, Hong Duan and Min Zhang

Multi-Engine and Multi-Alignment Based Automatic Post-Editing and its Impact on Translation Productivity
Santanu Pal, Sudip Kumar Naskar and Josef van Genabith

Measuring the Effect of Conversational Aspects on Machine Translation Quality
Marlies van der Wees, Arianna Bisazza and Christof Monz

Enriching Phrase Tables for Statistical Machine Translation Using Mixed Embeddings
Peyman Passban, Qun Liu and Andy Way

10:30–12:30 Session 8-C: Discourse Relations, Coreference, Pragmatics

Anecdote Recognition and Recommendation
Wei Song, Ruiji Fu, Lizhen Liu, Hanshi Wang and Ting Liu

Training Data Enrichment for Infrequent Discourse Relations
Kailang Jiang, Giuseppe Carenini and Raymond Ng

Inferring Discourse Relations from PDTB-style Discourse Labels for Argumentative Revision Classification
Fan Zhang, Diane Litman and Katherine Forbes-Riley

Capturing Pragmatic Knowledge in Article Usage Prediction using LSTMs
Jad Kabbara, Yulan Feng and Jackie Chi Kit Cheung

10:30–12:30 Session 8-D: Sentiment Analysis, Computational Argumentation I

Aspect Based Sentiment Analysis using Sentiment Flow with Local and Non-local Neighbor Information
Shubham Pateria

Two-View Label Propagation to Semi-supervised Reader Emotion Classification
Shoushan Li, Jian Xu, Dong Zhang and Guodong Zhou

A Joint Sentiment-Target-Stance Model for Stance Classification in Tweets
Javid Ebrahimi, Dejing Dou and Daniel Lowd

SenticNet 4: A Semantic Resource for Sentiment Analysis Based on Conceptual Primitives
Erik Cambria, Soujanya Poria, Rajiv Bajpai and Bjoern Schuller

10:30–12:30 Session 8-P: Poster Session 7

Machine Learning for NLP

Joint Embedding of Hierarchical Categories and Entities for Concept Categorization and Dataless Classification
Yuezhang(Music) Li, Ronghuo Zheng, Tian Tian, Zhiting Hu, Rahul Iyer and Katia Sycara

Latent Topic Embedding
Di Jiang, Lei Shi, Rongzhong Lian and Hua Wu

Neural-based Noise Filtering from Word Embeddings
Kim Anh Nguyen, Sabine Schulte im Walde and Ngoc Thang Vu

Integrating Distributional and Lexical Information for Semantic Classification of Words using MRMF
Rosa Tsegaye Aga, Lucas Drumond, Christian Wartena and Lars Schmidt-Thieme

Semi Supervised Preposition-Sense Disambiguation using Multilingual Data
Hila Gonen and Yoav Goldberg

Monday mornings are my fave :) #not Exploring the Automatic Recognition of Irony in English tweets
Cynthia Van Hee, Els Lefever and Veronique Hoste

CNN- and LSTM-based Claim Classification in Online User Comments
Chinnappa Guggilla, Tristan Miller and Iryna Gurevych

Experiments in Idiom Recognition
JIng Peng and Anna Feldman

An Empirical Evaluation of various Deep Learning Architectures for Bi-Sequence Classification Tasks
Anirban Laha and Vikas Raykar

Learning Succinct Models: Pipelined Compression with L1-Regularization, Hashing, Elias-Fano Indices, and Quantization
Hajime Senuma and Akiko Aizawa

Semantic Processing, Distributional Semantics, Compositionality

Bad Company—Neighborhoods in Neural Embedding Spaces Considered Harmful
Johannes Hellrich and Udo Hahn

Implementing a Reverse Dictionary, based on word definitions, using a Node-Graph Architecture
Sushrut Thorat and Varad Choudhari

Is an Image Worth More than a Thousand Words? On the Fine-Grain Semantic Differences between Visual and Linguistic Representations
Guillem Collell and Marie-Francine Moens

On the contribution of word embeddings to temporal relation classification
Paramita Mirza and Sara Tonelli

Modeling Context-sensitive Selectional Preference with Distributed Representations
Naoya Inoue, Yuichiroh Matsubayashi, Masayuki Ono, Naoaki Okazaki and Kentaro Inui

Exploring the value space of attributes: Unsupervised bidirectional clustering of adjectives in German
Wiebke Petersen and Oliver Hellwig

Distributional Inclusion Hypothesis for Tensor-based Composition
Dimitri Kartsaklis and Mehrnoosh Sadrzadeh

Parameter estimation of Japanese predicate argument structure analysis model using eye gaze information
Ryosuke Maki, Hitoshi Nishikawa and Takenobu Tokunaga

Paraphrasing, Textual Entailment

Reading and Thinking: Re-read LSTM Unit for Textual Entailment Recognition
Lei Sha, Baobao Chang, Zhifang Sui and Sujian Li

A Paraphrase and Semantic Similarity Detection System for User Generated Short-Text Content on Microblogs
Kuntal Dey, Ritvik Shrivastava and Saroj Kaushik

Modeling Extractive Sentence Intersection via Subtree Entailment
Omer Levy, Ido Dagan, Gabriel Stanovsky, Judith Eckle-Kohler and Iryna Gurevych

Context-Sensitive Inference Rule Discovery: A Graph-Based Method
Xianpei Han and Le Sun

Modelling Sentence Pairs with Tree-structured Attentive Encoder
Yao Zhou, Cong Liu and Yan Pan

Neural Paraphrase Generation with Stacked Residual LSTM Networks
aaditya prakash, Sadid A. Hasan, Kathy Lee, Vivek Datla, Ashequl Qadir, Joey Liu and Oladimeji Farri

12:30–14:00 ***Lunch break***

14:00–15:30 **Session 9-A: Information Retrieval, Information Extraction, Question Answering III**

English-Chinese Knowledge Base Translation with Neural Network
Xiaocheng Feng, Duyu Tang, Bing Qin and Ting Liu

Keyphrase Annotation with Graph Co-Ranking
Adrien Bougouin, Florian Boudin and Beatrice Daille

What's in an Explanation? Characterizing Knowledge and Inference Requirements for Elementary Science Exams
Peter Jansen, Niranjan Balasubramanian, Mihai Surdeanu and Peter Clark

Friday, December 16, 2016 (continued)

14:00–15:30 Session 9-B: Sentiment Analysis, Computational Argumentation II

"All I know about politics is what I read in Twitter": Weakly Supervised Models for Extracting Politicians' Stances From Twitter
Kristen Johnson and Dan Goldwasser

Leveraging Multiple Domains for Sentiment Classification
Fan Yang, Arjun Mukherjee and Yifan Zhang

Political News Sentiment Analysis for Under-resourced Languages
Patrik F. Bakken, Terje A. Bratlie, Cristina Marco and Jon Atle Gulla

14:00–15:30 Session 9-C: Applications V

Fast Inference for Interactive Models of Text
Jeffrey Lund, Paul Felt, Kevin Seppi and Eric Ringger

Combining Heterogeneous User Generated Data to Sense Well-being
Adam Tsakalidis, Maria Liakata, Theo Damoulas, Brigitte Jellinek, Weisi Guo and Alexandra Cristea

Hashtag Recommendation with Topical Attention-Based LSTM
Yang Li, Ting Liu, Jing Jiang and Liang Zhang

14:00–15:30 Session 9-D: Resources, Software, Tools & Under-resourced languages III

Better call Saul: Flexible Programming for Learning and Inference in NLP
Parisa Kordjamshidi, Daniel Khashabi, Christos Christodoulopoulos, Bhargav Mangipudi, Sameer Singh and Dan Roth

Crowdsourcing Complex Language Resources: Playing to Annotate Dependency Syntax
Bruno Guillaume, Karën Fort and Nicolas Lefebvre

Borrow a Little from your Rich Cousin: Using Embeddings and Polarities of English Words for Multilingual Sentiment Classification
Prerana Singhal and Pushpak Bhattacharyya

14:00–15:30 Session 9-P: Poster Session 8

Machine Translation

A Character-Aware Encoder for Neural Machine Translation
Zhen Yang, Wei Chen, Feng Wang and Bo Xu

Convolution-Enhanced Bilingual Recursive Neural Network for Bilingual Semantic Modeling
jinsong su, Biao Zhang, Deyi Xiong, Ruochen Li and Jianmin Yin

Improving Attention Modeling with Implicit Distortion and Fertility for Machine Translation
Shi Feng, Shujie Liu, Nan Yang, Mu Li, Ming Zhou and Kenny Q. Zhu

Neural Machine Translation with Supervised Attention
Lemao Liu, Masao Utiyama, Andrew Finch and Eiichiro Sumita

Lightly Supervised Quality Estimation
Matthias Sperber, Graham Neubig, Jan Niehues, Sebastian Stüker and Alex Waibel

Improving Translation Selection with Supersenses
Haiqing Tang, Deyi Xiong, Oier Lopez de Lacalle and Eneko Agirre

Is all that Glitters in Machine Translation Quality Estimation really Gold?
Yvette Graham, Timothy Baldwin, Meghan Dowling, Maria Eskevich, Teresa Lynn and Lamia Tounsi

Connecting Phrase based Statistical Machine Translation Adaptation
Rui Wang, Hai Zhao, Bao-Liang Lu, Masao Utiyama and Eiichiro Sumita

Fast Collocation-Based Bayesian HMM Word Alignment
Philip Schulz and Wilker Aziz

Learning to translate from graded and negative relevance information
Laura Jehl and Stefan Riezler

Universal Reordering via Linguistic Typology
Joachim Daiber, Miloš Stanojević and Khalil Sima'an

A Deep Fusion Model for Domain Adaptation in Phrase-based MT
Nadir Durrani, Hassan Sajjad, Shafiq Joty and Ahmed Abdelali

Inducing Bilingual Lexica From Non-Parallel Data With Earth Mover's Distance Regularization
Meng Zhang, Yang Liu, Huanbo Luan, Yiqun Liu and Maosong Sun

What Makes Word-level Neural Machine Translation Hard: A Case Study on English-German Translation
Fabian Hirschmann, Jinseok Nam and Johannes Fürnkranz

Improving Word Alignment of Rare Words with Word Embeddings
Masoud Jalili Sabet, Heshaam Faili and Gholamreza Haffari

Applications

Measuring the Information Content of Financial News
Ching-Yun Chang, Yue Zhang, Zhiyang Teng, Zahn Bozanic and Bin Ke

Automatic Generation and Classification of Minimal Meaningful Propositions in Educational Systems
Andreea Godea, Florin Bulgarov and Rodney Nielsen

First Story Detection using Entities and Relations
Nikolaos Panagiotou, Cem Akkaya, Kostas Tsioutsiouliklis, Vana Kalogeraki and Dimitrios Gunopulos

Textual complexity as a predictor of difficulty of listening items in language proficiency tests
Anastassia Loukina, Su-Youn Yoon, Jennifer Sakano, Youhua Wei and Kathy Sheehan

The Construction of a Chinese Collocational Knowledge Resource and Its Application for Second Language Acquisition
Renfen HU, Jiayong Chen and Kuang-hua Chen

15:30–16:00 ***coffee break***

16:00–17:00 Session 10-A: Information Retrieval, Information Extraction, Question Answering IV

Joint Inference for Event Coreference Resolution
Jing Lu, Deepak Venugopal, Vibhav Gogate and Vincent Ng

Event Detection with Burst Information Networks
Tao Ge, Lei Cui, Baobao Chang, Zhifang Sui and Ming Zhou

16:00–17:30 Session 10-B: Sentiment Analysis, Computational Argumentation III

Corpus Fusion for Emotion Classification
Suyang Zhu, Shoushan Li, Ying Chen and Guodong Zhou

Effective LSTMs for Target-Dependent Sentiment Classification
Duyu Tang, Bing Qin, Xiaocheng Feng and Ting Liu

Towards assessing depth of argumentation
Manfred Stede

16:00–17:30 Session 10-C: Applications VI

Video Event Detection by Exploiting Word Dependencies from Image Captions
Sang Phan, Yusuke Miyao, Duy-Dinh Le and Shin'ichi Satoh

Predicting Restaurant Consumption Level through Social Media Footprints
Yang Xiao, Yuan Wang, Hangyu Mao and Zhen Xiao

A Novel Fast Framework for Topic Labeling Based on Similarity-preserved Hashing
Xian-Ling Mao, Yi-Jing Hao, Qiang Zhou, Wen-Qing Yuan, Liner Yang and Heyan Huang

16:00–17:30 Session 10-D: Dialog Processing and Dialog Systems, Multimodal Interfaces

Sequence to Backward and Forward Sequences: A Content-Introducing Approach to Generative Short-Text Conversation
Lili Mou, Yiping Song, Rui Yan, Ge Li, Lu Zhang and Zhi Jin

Disfluent but effective? A quantitative study of disfluencies and conversational moves in team discourse
Felix Gervits, Kathleen Eberhard and Matthias Scheutz

A Neural Network Approach for Knowledge-Driven Response Generation
Pavlos Vougiouklis, Jonathon Hare and Elena Simperl

16:00–17:30 Session 10-P: Poster Session 9

Resources, Software and Tools

PersoNER: Persian Named-Entity Recognition
Hanieh Poostchi, Ehsan Zare Borzeshi, Mohammad Abdous and Massimo Piccardi

OCR++: A Robust Framework For Information Extraction from Scholarly Articles
Mayank Singh, Barnopriyo Barua, Priyank Palod, Manvi Garg, Sidhartha Satapathy, Samuel Bushi, Kumar Ayush, Krishna Sai Rohith, Tulasi Gamidi, Pawan Goyal and Animesh Mukherjee

Efficient Data Selection for Bilingual Terminology Extraction from Comparable Corpora
Amir Hazem and Emmanuel Morin

TweetGeo - A Tool for Collecting, Processing and Analysing Geo-encoded Linguistic Data
Nikola Ljubešić, Tanja Samardzic and Curdin Derungs

Extending WordNet with Fine-Grained Collocational Information via Supervised Distributional Learning
Luis Espinosa Anke, Jose Camacho-Collados, Sara Rodríguez-Fernández, Horacio Saggion and Leo Wanner

A News Editorial Corpus for Mining Argumentation Strategies
Khalid Al Khatib, Henning Wachsmuth, Johannes Kiesel, Matthias Hagen and Benno Stein

Universal Dependencies for Turkish
Umut Sulubacak, Memduh Gokirmak, Francis Tyers, Çağrı Çöltekin, Joakim Nivre and Gülşen Eryiğit

Creating Resources for Dialectal Arabic from a Single Annotation: A Case Study on Egyptian and Levantine
Ramy Eskander, Nizar Habash, Owen Rambow and Arfath Pasha

Multilingual Aliasing for Auto-Generating Proposition Banks
Alan Akbik, Xinyu Guan and Yunyao Li

PanPhon: A Resource for Mapping IPA Segments to Articulatory Feature Vectors
David R. Mortensen, Patrick Littell, Akash Bharadwaj, Kartik Goyal, Chris Dyer and Lori Levin

Semantic Processing, Distributional Semantics, Compositionality

Text Classification Improved by Integrating Bidirectional LSTM with Two-dimensional Max Pooling
Peng Zhou, Zhenyu Qi, Suncong Zheng, Jiaming Xu, Hongyun Bao and Bo Xu

More is not always better: balancing sense distributions for all-words Word Sense Disambiguation
Marten Postma, Ruben Izquierdo Bevia and Piek Vossen

Language classification from bilingual word embedding graphs
Steffen Eger, Armin Hoenen and Alexander Mehler

Word Embeddings, Analogies, and Machine Learning: Beyond king - man + woman = queen
Aleksandr Drozd, Anna Gladkova and Satoshi Matsuoka

Semantic Tagging with Deep Residual Networks
Johannes Bjerva, Barbara Plank and Johan Bos

Lexical Semantics, Ontologies

A Supervised Approach for Enriching the Relational Structure of Frame Semantics in FrameNet
Shafqat Mumtaz Virk, Philippe Muller and Juliette Conrath

Reddit Temporal N-gram Corpus and its Applications on Paraphrase and Semantic Similarity in Social Media using a Topic-based Latent Semantic Analysis
Anh Dang, Abidalrahman Moh'd, Aminul Islam, Rosane Minghim, Michael Smit and Evangelos Milios

Dictionaries as Networks: Identifying the graph structure of Ogden's Basic English
Camilo Garrido and Claudio Gutierrez

Structured Generative Models of Continuous Features for Word Sense Induction
Alexandros Komninos and Suresh Manandhar

17:45–18:30 Closing